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THE RIO GRANDE RIVER BASIN

Public Health Service
Dallas, Texas

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REPORT ON

THE RIO GRANDE RIVER BASIN

for the

PRESIDENT'S WATER RESOURCES POLICY COMMISSION

Prepared by the

Western Gulf and Colorado Drainage Basins Office
Division of Water Pollution Control

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THE RIO GRANDE BASIN (EXCLUSIVE OF MEXICO)

PART I

PHYSICAL AND ECONOMIC DATA

Description of the Basin

The Rio Grande arises at elevations exceeding 13,000 feet along the Continental Divide of southwestern Colorado and flows generally southeastward through a rugged terrain to the New Mexican border. The river then swings to the south and gradually emerges from the mountainous country onto the broad, high arid plateau of central New Mexico. At the Texas line, the river again swings easterly to form the International Boundary for some 1,300 miles from El Paso to the Gulf of Mexico.

The drainage area of the Rio Grande basin, exclusive of tidewater, includes approximately 335,000 square miles although large areas are confined within desiccating basins which contribute no surface run-off to the Rio Grande. The contributing areas of the Rio Grande basin total 171,643 square miles, of which 82,919 are in Mexico and 88,724 are in the United States.

The principal tributaries of the Rio Grande are the Pecos and the Devils Rivers entering from the United States east of the Big Bend country of Texas and the Rio Conchos and the Rio San Juan which enter from Mexico.

In its upper reaches, the Rio Grande and its many tributaries are typical snow- and spring-fed mountain streams draining the heavily forested and rugged eastern slopes of the Rocky Mountains. Through central New Mexico, the Rio Grande is a typical desert river with few permanently-flowing tributaries. Below El Paso, the river flows for some 570 miles through a rugged mountainous country with small isolated valleys as it passes through the Big Bend. Below the mountainous Big Bend country, a 400-mile reach develops draining a roughly broken terrain with narrow valleys and broad high tablelands. Over the remaining 175 miles to the Gulf of Mexico, the Rio Grande traverses a broad, fan-shaped, coastal plain--locally known as the "Magic Valley" of the lower Rio Grande.

As might be expected in so varied an area, the distribution of rainfall over the Rio Grande basin differs widely. At Wolf Creek Pass, Colorado, in the extreme headwaters, the annual average precipitation is 29.84 inches whereas at Del Norte, 30 airline miles distant, it is but 8.32 inches. In New Mexico, the average annual precipitation at Santa Fe is 14.19 inches; at Albuquerque 8.40 inches; and at Elephant Butte Dam 9.41 inches. At El Paso, Texas, the annual average precipitation is 8.56 inches; at Presidio 7.80 inches; at Laredo 20.47 inches; and at Brownsville 26.26 inches. In summary, the rainfall of the Rio Grande basin is comparatively heavy in the high mountain headwater areas and also in the low Gulf Coastal Plain. The central portion of the basin, which includes New Mexico and west Texas, is arid with a very light rainfall which often assumes the form of infrequent, but extremely heavy, downpours.

The Rio Grande is under considerable degree of control from Elephant Butte and other storage reservoirs, diversions, and wasteways. Reservoir discharges are, for the most part, confined to the downstream water demands for power and irrigation. At several locations the entire river flow is diverted for irrigation and at times the flow is stored in anticipation of the irrigation demands. The extremes of mean daily river discharge at El Paso vary between the approximate limits of 100 and 5,000 second feet; at Del Rio between 1,100 and 80,000 second feet; and at Rio Grande City between 1,500 and 75,000 second feet. Five wasteways divert excess flood water from the Rio Grande channel to the Gulf of Mexico beginning a short distance below Rio Grande City. Above Elephant Butte Reservoir where river control is less effective, the Rio Grande is a much flashier stream. The mean daily discharges of record at Del Norte vary between 800 and 18,000 second feet; at Albuquerque between 25 and 25,000 second feet; and at San Marcial, between zero and 50,000 second feet.

The economy of the entire Rio Grande basin rests predominately upon agriculture and the industries dependent upon agriculture. Grazing, lumbering, and mining comprise the chief industries of the basin other than the usual service industries of the cities and those industries associated with agriculture.

The Rio Grande basin has many and diverse recreational attractions. The headwater streams in the high mountains of southwestern Colorado and northern New Mexico provide excellent sports fishing. Below the Santa Fe area, however, the main-stem silt load is so great that good fishing is confined to the clearer tributaries, the reservoirs, and the clear stream sections immediately below the reservoirs. The river is paralleled by excellent game cover throughout its entire length.

Recreation seekers are attracted to virtually every section of the Rio Grande basin for diverse reasons. The mountainous areas draw fishermen, hunters, campers, and winter sportsmen in great numbers. The Rio Grande basin of New Mexico is a mecca for tourists, sportsmen, and archaeologists alike. In Texas, the Big Bend country is sufficiently rugged and primative to satisfy the most exacting wilderness seeker. The Devils River drains the southern portion of the Edwards Plateau--reputed to be one of the fine game areas of the United States. Among the attributes of the semi-tropical "Magic Valley" of the lower Rio Grande can be listed virtually every type of recreation, other than winter sports, on a year 'round basis.

Within the confines of the Rio Grande basin are found the Bandolier National Monument (cliff dwelling ruins), Gran Quivira National Monument (high desert), White Sands National Monument (Gypsum desert), the Carlsbad Caverns National Park (largest cave in North America), the Big Bend National Park (wilderness area), and almost innumerable State Parks and Monuments, State and National Forests, as well as private resorts, sanatoriums, and "dude ranches."

The waters of the Rio Grande and its tributaries constitute the very life blood of a thriving and prosperous civilization. Without irrigation water, much of the basin would be a barren, uninhabitable desert. Patently, the Rio Grande must be protected from any pollution which might, in any adverse manner, affect its many and vital uses.

Sources of Pollution

Silt unquestionably constitutes the most serious pollutant of the Rio Grande, the adverse effects of which outweigh--by far--those of all others combined. Generally speaking, all streams within the basin are very turbid except those in the headwater forested areas and those reaches immediately downstream from large storage reservoirs which also function as settling basins. Loose, poorly consolidated soil types, which are particularly susceptible to rapid erosion and gully formation, prevail over much of the Rio Grande basin. Over grazing has destroyed much of the cover which originally prevented erosion.

The Rio Grande carries approximately 12,769 tons of silt annually at the Colorado-New Mexico line. In New Mexico, the tributaries contribute an enormous silt burden which ruins the main stem for all recreation purposes and, in addition, creates a serious and costly problem in maintenance of irrigation canals. The Rio Grande carries in suspension approximately 16.3 million tons of silt at San Marcial, New Mexico. The Bureau of Reclamation has estimated that approximately 37 million tons of sediment are brought annually

into the mid section of the Rio Grande. Of this amount approximately 25 million tons are deposited within the stream bed itself and the remaining 12 million tons are carried into the Elephant Butte Reservoir to settle in the quiet water. Elephant Butte Reservoir is reported to have lost nearly 20 per cent of its original storage capacity from siltation during the first 32 years of operation. At Langtry, Texas, the Rio Grande has acquired a second silt load amounting to 9.2 million tons annually and this increases to 17.6 million tons annually at Roma. Siltation and diversion in the "Magic Valley" reduces the river silt load to 14.8 million tons annually at Las Palmas.

Dissolved minerals also constitute important natural pollution of the Rio Grande. In general, the river water is soft, typical snow-melt in the mountainous headwater areas. It acquires a heavy burden of dissolved minerals, however, from natural sources and from the repeated use of the water for irrigation of the arid lands downstream. To illustrate, at Del Norte the total dissolved solids burden amounted to 52,369 tons during the year 1936. The weight of dissolved solids that year rose to 82,952 tons at the Colorado-New Mexico line and to 375,675 tons at Otowi, New Mexico. Below Elephant Butte Dam, the minerals in solution average 608,600 tons per year. At Langtry, the dissolved solids reach an average of 1.3 million tons annually to which is added, immediately downstream, the 1.5 million tons annually carried by the Pecos River. At Eagle Pass, the river burden amounts to 3.2 million tons per year of dissolved minerals and at Roma, 3.7 million tons. The Pecos River constitutes the greatest single source of dissolved solids as this river acquires high concentrations of sodium and calcium sulphates and chlorides from natural sources in southern New Mexico. The International Boundary Commission reports (1941) that nowhere along the main stem from El Paso to the Gulf does the boron or fluoride content of the Rio Grande exceed the safe limits for human consumption.

The Rio Grande basin contains 97 communities with populations estimated between 500 and 2,500; 21 cities with populations estimated between 2,500 and 5,000; 14 cities with populations estimated between 5,000 and 10,000; and 11 cities with populations between 10,000 and 25,000. At the present time, only Santa Fe, Albuquerque, Carlsbad, El Paso, Laredo, Harlingen, and Brownsville are estimated to have populations exceeding 25,000. El Paso, the largest city in the basin, had a 1949 estimated population of 129,000.

The Rio Grande in Colorado receives untreated sewage from the communities of Del Norte, Monte Vista, and Alamosa with a combined population estimated at 8,880, together with an unknown quantity of urban industrial wastes principally from dairies. Irrigation demands for river water leave comparatively little flow in the stream channel during the irrigation season as evidenced by minimum flows of 4 second feet recorded above Monte Vista and 2 second feet above Alamosa. Low stream flows prevailing over this section of the Rio Grande during

the irrigating season reduce the dilution received by the untreated urban wastes and likewise greatly increase the probability that unstabilized sewage will be diverted onto crop land. In addition to the urban wastes, many mines and saw mills are scattered throughout the headwater areas-- waste from which might locally affect water quality by the addition of settleable solids or of toxic minerals. Too little is known concerning pollution of the Rio Grande in Colorado to warrant conclusions beyond the need for urban waste treatment.

Eleven communities in New Mexico, with a combined population estimated at 103,265, discharge treated wastes directly into the permanently flowing waters of the Rio Grande and its tributaries. Of the eleven, six communities (combined population estimated at 51,850) are discharging an effluent satisfactory to the State Department of Public Health and one community currently is constructing a new sewage treatment plant. Only four communities (combined population estimated at 44,915) are discharging into the permanently flowing waters of the Rio Grande basin an effluent which--although treated--is unsatisfactory to the State Department of Public Health. Potential industrial waste sources in New Mexico include oil refineries, cottonseed oil and delinting plants, and the usual industries associated with urban development.

The permanently flowing waters of the Rio Grande basin in Texas--exclusive of the "Magic Valley"--receive the treated wastes from eight communities with a combined population estimated at 244,753. The effluents from seven of the eight communities are considered substandard by the Texas State Department of Health. Two of the seven communities currently are constructing new sewage treatment plants that will remove them from the offending category.

The most serious man-made pollution problem in the entire Rio Grande basin develops below the city of El Paso. Samples collected during 1947 by the International Boundary Commission at the Ysletta-Zaragosa bridge, nine miles below the El Paso sewer outfall, showed biochemical oxygen demands up to 80.5 ppm. (July 3) and dissolved oxygen concentrations as low as 0.4 ppm. (Aug. 21). Both criteria indicate severely polluted water. Part of the waste load of the Rio Grande at the sampling point stemmed from meat packing wastes produced in the United States but discharged into Mexican waters. The Texas State Department of Health has recommended a new sewage treatment plant at El Paso which would do much to remedy the existing undesirable sanitary condition of the Rio Grande below the city.

In the "Magic Valley" section of the lower Rio Grande, only Brownsville and San Juan (combined population estimated at 41,000) discharge urban wastes, following treatment, into the Rio Grande.

All other, of the many communities in this densely populated area discharge wastes into the Arroyo Colorado—a natural drainage ditch generally paralleling the Rio Grande but emptying directly into the Gulf of Mexico. The Arroyo Colorado has been enlarged to serve the multiple purposes of a wasteway for excess Rio Grande water, a drainage canal for the irrigated lands, and a natural sewer. The Arroyo Colorado is reported at times to be heavily overloaded with domestic sewage and wastes from the many fruit and vegetable processing industries of the area. The enclosing terrain is such, however, that the condition of the Arroyo Colorado in no way affects the quality of the Rio Grande water.

The quantitative waste loading of the Rio Grande basin may be summarized in the single statement "No information." The types of industrial wastes that may be entering the river have been outlined in the preceding paragraphs but quantitative data concerning these wastes are lacking.

In summary, the total waste loading of the Rio Grande—exclusive of Mexico for which no data are available and excluding that of the desiccating basins and the Arroyo Colorado neither of which affect the quality of the Rio Grande water—may be tabulated as follows:

Source	Number	Amount of Pollution Contributed: Estimated No. of People Served	Amount of Pollution Contributed: Pop. Equivalent of Wastes Discharged to Watercourse b/
Municipalities a/	53	515,710	216,930
Industrial Plants		No Quantitative Data	

a/ Includes all sewered communities discharging wastes into the permanently-flowing direct tributaries of the Rio Grande or to water used for irrigation. (This pollution includes the industrial wastes discharged into municipal sewer systems).

b/ In reducing to a common basis certain wastes from industries and municipalities, it is common practice to express the non-similar wastes in terms of a common unit, Population Equivalent.

Water Use and Adequacy of Water for Indicated Uses

With very few exceptions all community water systems in the Colorado and New Mexico portion of the Rio Grande Basin draw from underground water sources. All of the surface water users obtain water from mountain streams except Santa Rosa which draws directly from the Pecos River.

In the Texas portion of the Rio Grande basin, 23 communities with a combined population estimated at 365,844 obtain domestic water from the Rio Grande.

Insofar as is known, all pollution of the Rio Grande is fully absorbed by the natural purification processes before the water is withdrawn downstream for domestic use. The quality of the river water is sufficiently high at all points of withdrawal for domestic purposes to permit its safe usage following treatment.

Irrigation is, of course, the principal industrial use of Rio Grande water for throughout the entire basin, agriculture is possible only by irrigation. Data are not readily available concerning the extensive areas in Colorado and New Mexico that are irrigated by Rio Grande water. In Texas and Mexico, however, a total of 1,410,545 acres--689,742 in the United States and 720,803 in Mexico--are under irrigation by the Rio Grande and its tributaries. Considerable acreage in southwestern Colorado are irrigated for the production of vegetable, feed grain, and forage crops. In New Mexico, irrigated lands closely parallel the river and its tributaries for the production of food grains, forage crops, cotton, vegetables, and fruit. In west Texas, vegetables, fruit, cotton, feed grains, and forage are the principal crops served by irrigation in the narrow and confined valleys. In the wide and flat "Magic Valley" near the mouth of the Rio Grande, the sub-tropical climate permits a year 'round planting and harvesting schedule in an intensive specialty type of agriculture. Approximately 80 per cent of the land within the United States below El Paso irrigated by the Rio Grande lies within the 175-mile strip of the "Magic Valley". Vegetables, feed grains, cotton, citrus, and forage crops are produced in amazing quantities for interstate shipment.

The two natural pollutants, silt and salt, adversely affect use of the Rio Grande water for irrigation as does domestic sewage in restricted areas.

Heavy siltation in the Rio Grande above Elephant Butte Reservoir has resulted in a marked valley aggradation and the filling of irrigation canals both of which greatly increased the cost of maintaining irrigation water on the croplands. The profuse growth of salt cedars on the delta built by sedimentation in the upper part of Elephant Butte Reservoir results in an enormous loss of valuable water through transpiration. This loss of water has been estimated as approximately equalling New Mexico's water debt to the lower Rio Grande.

Salt pollution from natural sources in southern New Mexico restricts the type of crops that can be grown under irrigation in the lower Pecos valley to those which are markedly salt resistant.

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Some question has arisen concerning the adequacy of Rio Grande water in southwestern Colorado where vegetable crops are irrigated with water in which the untreated domestic wastes from Del Norte, Monte Vista, and Alamosa have little opportunity to stabilize. Exactly the same situation develops in west Texas immediately below the El Paso sewer outfall and at certain locations in the "Magic Valley". In some parts of the country vegetables produced in areas using polluted irrigation water do not find a ready market thus working an economic hardship upon the producer.

Need for Treatment Works

As previously stated, no quantitative data are available concerning the industrial waste loading of the Rio Grande basin. The costs and benefits of controlling silt pollution can not be given at this time.

The requirements for sewage treatment facilities, based upon information supplied by the various State pollution control agencies are summarized in the following table:

Sewage and Industrial Waste Treatment Plant Requirements

Source (1)	Total No. (2)	Without Treatment			With Treatment			No Project Req'd (9)	No Data (10)
		No. (3)	Treatment Needed (4)	Status Unknown (5)	No. (6)	Improvements Req'd (7)	Status Unknown (8)		
Municipalities	150	11	11	0	33	33	0	92	14
Industrial Plants		No Quantitative Data							
Total	150	11	11	0	33	33	0	92	14

Column (4) includes one community where treatment is indicated but not feasible.

Column (7) includes communities needing improved operational levels, additional treatment facilities, new treatment plants, and four communities currently in process of constructing improvements.

Column (9) includes only those communities where no improvements in sewage treatment are indicated by reported pollution of surface or underground waters. Also includes seven communities where no improvements to sewage treatment facilities are indicated by the reported condition of the water but where State pollution control agency has recommended new or additional facilities for sewage treatment.

PART II

BENEFITS AND COSTS

Only in rare instances is water quality a factor affecting water use in this area. Anything wet is eagerly sought. The additional cost of using a turbid, or salty water is accepted without question. Court battles have been fought over the rights to untreated sewage.

The right of prior use is accepted in this section of the country. The first water rights were claimed by the farmers for irrigation and stock watering, next industry claimed a portion which left little if any first class water rights for domestic and recreational use. Nevertheless there are a number of water uses demanding little in the way of quantity that are tolerated because of the limited sources of water. These uses are individual water supply, non-supervised swimming, vegetable washing, etc.

Public health authorities, conscious of the demand for water and the widespread use of sewage effluents for irrigation, have pressed for sewage treatment on a preventive rather than a corrective basis. Although little evidence of an adverse public health effect due to using polluted irrigation water has been uncovered to date, there is a potential health hazard which authorities feel justified in removing.

The cost of providing the degree of sewage treatment recommended by the State pollution control agencies within the basin is estimated at $6,263,000. Additional sewage treatment can be expected to raise the level of general public health. Some benefit will accrue to vegetable producers when the stigma of sewage pollution is taken from irrigation waters.

The costs and benefits of silt pollution abatement cannot be estimated in the time available.

No information is available on industrial waste treatment costs.

PART III

SPECIFIC POLICY PROBLEMS

No conflict of water uses exists in the Rio Grande basin insofar as pollution abatement is concerned. In an area as arid as most of the Rio Grande basin, other needs for the limited quantities of water available--particularly for irrigation--are far too critical to permit the recognition of dilution as a legitimate method of pollution abatement. Where it can be obtained concurrent with other needs, dilution may be an acceptable use. It cannot, however, compete or conflict with other water uses in the Rio Grande basin.

The sediment problems of the Rio Grande basin have been outlined under Part I. The role of silt in this basin can be summarized by the statement that it is, by far, the most important pollutant of the river and one which by sedimentation and channel aggradation greatly increases the cost of flood control and irrigation works. Silt from soil erosion is slowly filling the vital water storage reservoirs and it has already ruined many hundreds of miles of stream for recreational use. Over much of its length, the Rio Grande carries a maximum silt burden in suspension.

The existing degree of coordination between the various agencies of the Federal Government is satisfactory to resolve problems arising regarding pollution abatement.

A critical lack of adequate basin data exists which precludes proper planning of the Water Pollution Control Program within the Rio Grande basin. This dearth of basic data stems, in a large part, from the fact that water pollution is viewed with such minor concern by the States that there have been no funds for, nor interest in, sustaining a coordinated program. State water pollution activities are principally confined to routine sanitation and to short-term investigation of complaints--neither of which constitute productive sources of the data required for a comprehensive program of pollution abatement.

The problems of securing local participation in pollution abatement programs center primarily around better agricultural practices to reduce soil erosion and the lack of funds at the community level to build corrective works. In many instances, communities needing sewage treatment facilities already have reached the statutory limits of their bonded indebtedness. The citizens,

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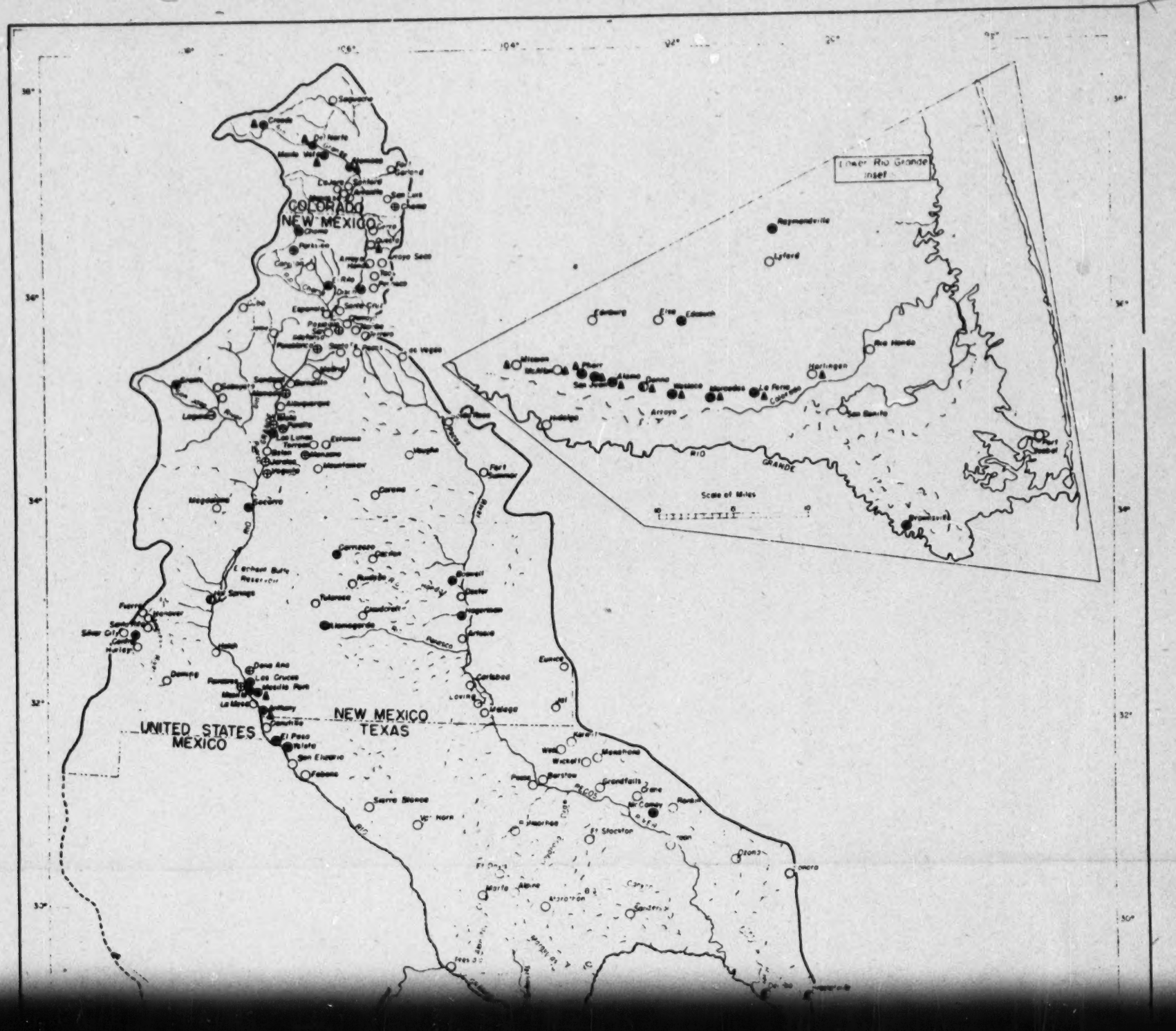
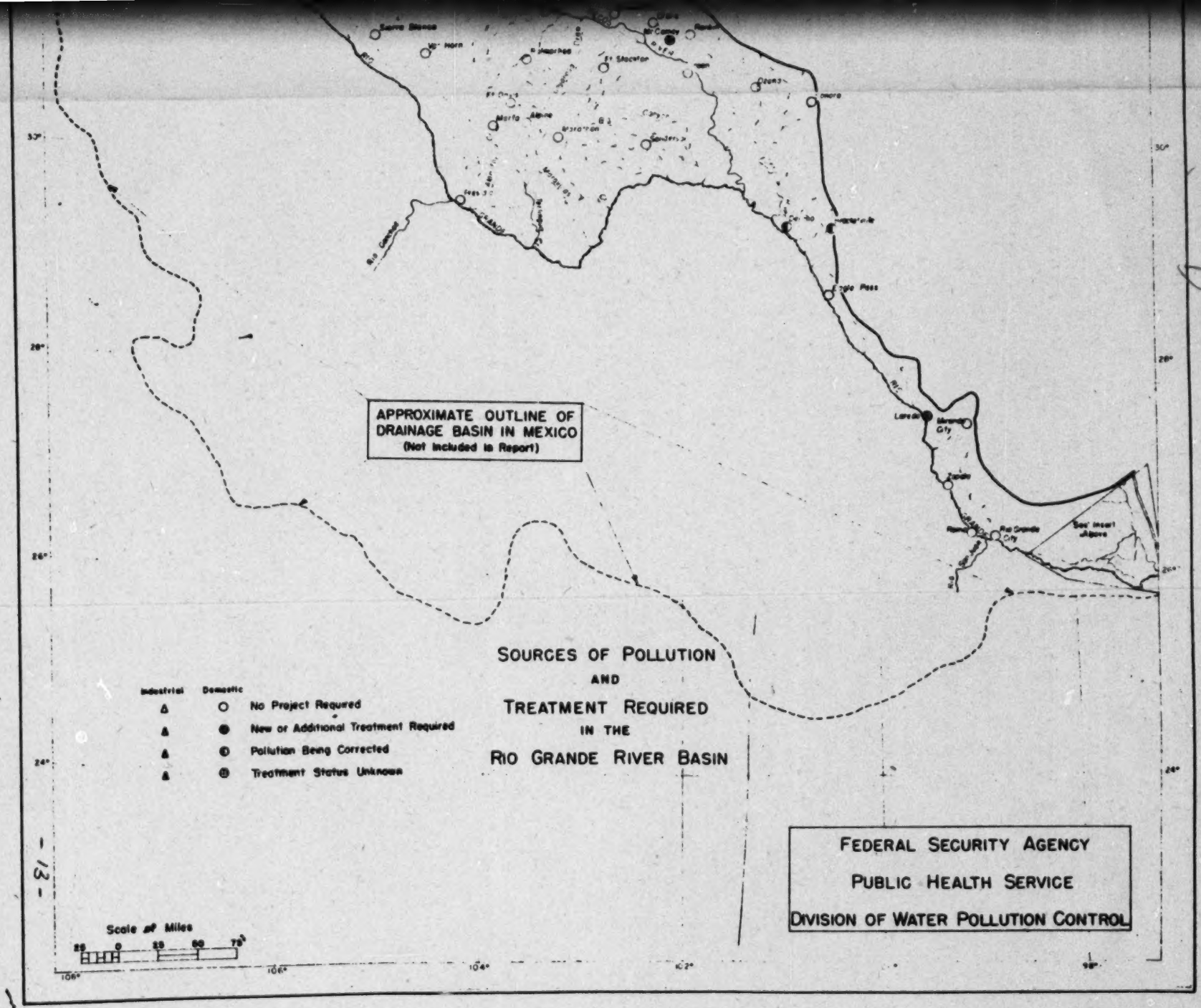
facing increased taxes, refuse to vote the special levies required to finance sewage treatment. It is believed that effective public education, supported by factual information upon the needs for pollution abatement in the protection of entire watersheds, might elicit a more favorable reaction from the taxpayers than the customary approach that the needs of each community constitute an individual and isolated problem for solution.

Adequate disposal of the principal industrial wastes of the Rio Grande basin, namely mine tailings and fruit and vegetable processing offal, has not been attained. This is probably due to the fact that the problem has not been considered sufficiently critical to warrant concerted abatement effort.

No difficulty is foreseen in obtaining the cooperation of the Mexican Government in securing the abatement of pollution from Mexico. With the exception of the El Paso area, there is no known pollution from Mexico that affects water quality to any measurable degree. If, by example, the United States points the way in pollution abatement in the Rio Grande, it is certain that our sister government will institute any corrective measures that are warranted. The International Boundary and Water Commission has been established to handle such matters and the Treaty of 1944 states that the two countries will give preferential treatment to matters of sanitation which, of course, would include pollution abatement.


COLORADO
NEW MEXICO
UNITED STATES
MEXICO
NEW MEXICO
TEXAS
Lower Rio Grande
Inset
Scale of Miles
RIO
GRANDE
PECOS

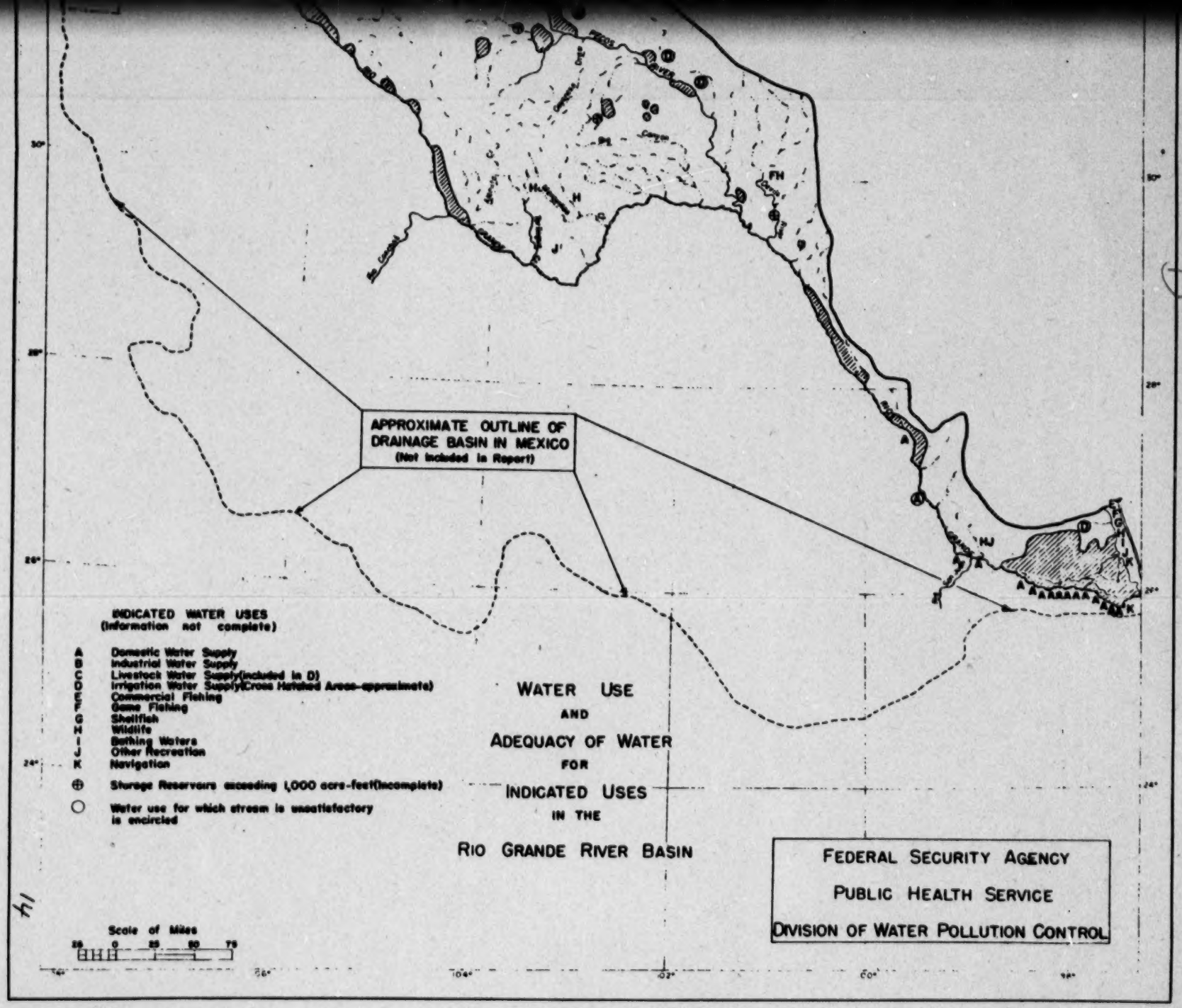


SOURCES OF POLLUTION AND TREATMENT REQUIRED IN THE RIO GRANDE RIVER BASIN

FEDERAL SECURITY AGENCY
PUBLIC HEALTH SERVICE
DIVISION OF WATER POLLUTION CONTROL

GPO DSO 17-990

COLORADO
NEW MEXICO
NEW MEXICO
TEXAS
UNITED STATES
MEXICO



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